

this season I have captured upwards of 200 specimens of *Thyatira Batis*, in perfect condition. I have also larvæ of *Eubolia Cervinata* to exchange. Those in want should write first.—G. LUMB, *Kirkgate, Wakefield; June 18.*

Larvæ or Eggs wanted.—I shall feel much obliged to any one who will send me eggs or larvæ of the following insects:—

C. Dominula,	P. Palpina,
P. Urticæ,	N. Cucullina,
O. Corylit,	Carmelita,
P. Populi,	Dictæa,
P. Hamula,	Dictæoides,
C. Furcula,	Trepida,
Bifida,	Chaonia,
Vinula,	Dodonæa,

and will endeavour to make a suitable return.—REV. E. HORTON, *Wick, Worcester; June 16.*

NATURAL HISTORY OF THE TINEINA.

DEPRESSARIA APPLANA.

The egg of this species is deposited in spring by the hibernated female. The larva feeds on the leaves of various species of *Umbellifera*; it is very partial to *Anthriscus sylvestris*, but may also be found on *Heraclium Sphondylium*, *Cherophyllum temulentum*, *Torilis Anthriscus*, *Evanthe Crocata*, *Angelica sylvestris*, &c. It inhabits the tip of a leaf, of which it draws the two sides together, so as to form a tubular habitation, in which it constantly resides when not actually employed in eating. The larva readily takes alarm on any agitation of the plant, and then hurriedly descends to the ground, whence it happens that the empty tubes are sometimes disproportionately abun-

dant, each panic involving the necessity of constructing a fresh habitation. The larvæ may be found from the end of May to the middle of July, but towards the beginning of the latter month they are generally fall-fed, and, quitting the plant, construct a slight cocoon amongst leaves on the surface of the earth, and there undergo their transformation to the pupa-state. In about three weeks the perfect insect makes its appearance, and, though no rarity in the autumnal months, is seen far more plentifully in the months of March and April.

H. T. STANTON.

ON THE FERTILIZATION OF BRITISH ORCHIDS BY INSECT AGENCY.

BY C. DARWIN, ESQ., F.R.S.

(Reprinted from the 'Gardener's Chronicle' of June 9, 1860.)

I SHOULD be extremely obliged to any person living where the Bee or Fly Orchis is tolerably common, if he will have the kindness to make a few simple observations on their manner of fertilization. To render the subject clear to those who know nothing of Botany, I must briefly describe what takes place in our common British Orchids.

The pollen-grains form two pear-shaped masses; each borne on a foot-stalk with a sticky gland at the end. The pollen-masses are hidden in little pouches open in front. When an insect visits a flower it almost necessarily, owing to the position of the parts, uncovers and touches the sticky glands. These firmly adhere to the head or body of the insect,

and thus the pollen-masses are drawn out of their pouches, are dragged over the humid stigmatic surface, and the plant is fertilized. So beautifully are the relative degrees of adhesiveness of the gland, and of the grains of pollen to each other and to the stigmatic surface mutually adapted, that an insect with an adherent pollen-mass will drag it over the stigmas of several flowers and leave granules of pollen on each.

The contrivance by which the sticky glands are prevented from drying, and so kept always viscid and ready for action, is even still more curious; they lie suspended (at least in the two species which I have examined) in a little hemispherical cup, full of liquid, and formed of such delicate membrane that the side projecting over the gangway into the nectary is ruptured transversely and depressed by the slightest touch; and then the glands, sticky and fresh out of their bath, immediately and almost inevitably come into contact with and adhere to the body which has just ruptured the cup. It is certain that with most of our common Orchids insects are absolutely necessary for their fertilization; for without their agency the pollen-masses are never removed and wither within their pouches. I have proved this in the case of *Orchis morio* and *mascula*, by covering up plants under a bell-glass, leaving other adjoining plants uncovered; in the latter I found every morning, as the flowers became fully expanded, some of the pollen-masses removed, whereas in the plants under the glass all the pollen-masses remained enclosed in the pouches.

Robert Brown, however, has remarked that the fact of all the capsules in a dense spike of certain Orchids producing seed seems hardly reconcilable with their fertilization having been accidentally

effected by insects, but I could give many facts showing how effectually insects do their work. Two cases will here suffice: in a plant of *Orchis maculata* with forty-four flowers open, the twelve upper ones, which were not quite mature, had not one pollen mass removed; whereas every one of the thirty-two lower flowers had one or both pollen-masses removed. In a plant of *Gynadenia conopsea* with fifty-four open flowers, fifty-two had their pollen-masses removed. I have repeatedly observed in various Orchids grains of pollen, and in one case three whole pollen-masses on the stigmatic surface of a flower, which still retained its own two pollen-masses; and as often, or even oftener, I have found flowers with the pollen-masses removed, but with no pollen on their stigmas. These facts clearly show that each flower is often, or even generally, fertilized by the pollen brought by insects from another flower or plant. I may add that, after observing our Orchids during many years, I have never seen a bee or any other diurnal insect (except once a butterfly) visit them; therefore I have no doubt that moths are the priests which perform the marriage ceremony. The structure indeed of these insects leads to this same conclusion, for no insect without a very long and extremely fine proboscis could possibly reach the nectar at the bottom of the extremely long and narrow nectary of the Butterfly-Orchis; and entomologists have occasionally captured moths with pollen-masses adhering to them. If any entomologist reads this, and can remember positively having caught a moth thus furnished, I hope he will give its name, and describe exactly to which part of the moth's body the sticky gland adhered.

(To be continued.)

small larvæ), if any gentleman should have more than he wants for himself I should be happy to hear from him, and will gladly pay postage:—

Smerinthus Ocellatus,
 ... Populi,
 ... Tiliæ,
 Sphinx Ligustri,
 Chærocampa Elpenor.

If I can possibly make any return at the end of the season I shall be happy to do so.—F. N. MILLS, 2, Arboretum Terrace, Osmaston Road, Derby; June 24.

Coleoptera offered gratuitously.—Duplicate specimens of *Dasytes viridis* will be sent to any entomologist needing them, on receipt of a box and stamp for postage.—C. O. GROOM, Hova Villas, Brighton.

ON THE FERTILIZATION OF BRITISH ORCHIDS BY INSECT AGENCY.

BY C. DARWIN, ESQ., F.R.S.

[Reprinted from the 'Gardener's Chronicle' of June 9, 1860.]

(Continued from p. 91.)

We may now turn to the genus *Ophrys*; in the Fly Orchis (*Ophrys muscifera*), the pollen-masses, furnished with sticky glands, do not naturally fall out of their pouches, nor can they be shaken out; so that insect agency is necessary, as with the species of the other genera, for their fertilization. But insects here do their work far less effectually than with common Orchids; during several years previous to 1858 I kept a record of the state of the pollen-masses in well-opened flowers of those plants which I examined, and out of one hundred and two flowers I found either one or both pollen-masses removed in

only thirteen flowers. But in 1858 I found seventeen plants growing near each other and bearing fifty-seven flowers, and of these thirty flowers had one or both pollen-masses removed; and as all the remaining twenty-seven flowers were the upper and younger flowers they probably would subsequently have had most of their pollen-masses removed, and thus have been fertilized. I should much like to hear how the case stands with the Fly Orchis in other districts; for it seems a strange fact that a plant should grow pretty well, as it does in this part of Kent, and yet during several years seldom be fertilized.

We now come to the Bee Orchis (*Ophrys apifera*), which presents a very different case; the pollen-masses are furnished with sticky glands, but differently from those in all the foregoing Orchids, they naturally fall out of their pouches; and from being of the proper length, though still retained at the gland-end, they fall on the stigmatic surface, and the plant is thus self-fertilized. During several years I have examined many flowers, and never in a single instance found even one of the pollen-masses carried away by insects, or ever saw the flower's own pollen-masses fail to fall on the stigma. Robert Brown consequently believed that the visits of insects would be injurious to the fertilization of this Orchis, and rather fancifully imagined that the flower resembled a bee in order to deter their visits. We must admit that the natural falling out of the pollen-masses of this Orchis is a special contrivance for its self-fertilization, and, as far as my experience goes, a perfectly successful contrivance, for I have always found this plant self-fertilized; nevertheless a long course of observation has made me greatly doubt whether the

flowers of any kind of plant are for a perpetuity of generations fertilized by their own pollen. And what are we to say with respect to the sticky glands of the Bee Orchis, the use and efficiency of which glands in all other British Orchids are so manifest? Are we to conclude that this one species is provided with these organs for no use? I cannot think so; but would rather infer that, during some years, or in some other districts, insects do visit the Bee Orchis and occasionally transport pollen from one flower to another, and thus give it the advantage of an occasional cross. We have seen that the Fly Orchis is not in this part of the country by any means sufficiently often visited by insects, though the visits of insects are indispensable to its fertilization. So with the Bee Orchis, though its self-fertilization is specially provided for, it may not exist here under the most favourable conditions of life; and in other districts or during particular seasons it may be visited by insects, and in this case, as its pollen-masses are furnished with sticky glands, it would almost certainly receive the benefit of an occasional cross-impregnation. It is this curious apparent contradiction in the structure of the Bee Orchis—one part, namely, the sticky glands, being adapted for fertilization by insect agency—another part, namely, the natural falling out of the pollen-masses, being adapted for self-fertilization without insect agency—which makes me anxious to hear what happens to the pollen-masses of the Bee Orchis in other districts or parts of England. I should be extremely obliged to any one who will take the trouble to observe this point, and to communicate the result to the 'Gardener's Chronicle' or to me.

CHARLES DARWIN,

Down, Bromley, Kent.

Do the Tineina or other small Moths suck Flowers, and if so what Flowers?— I once saw several individuals of a small moth apparently eating the pollen of the *Mercurialis*; is this physically possible? I have during several years watched the smaller clovers, such as *Trifolium procumbens*, and the *Vicia hirsuta* which has such extremely minute flowers, and I never saw a bee visit them. I am, however, aware from experience that it is very difficult to assert that bees do not visit any particular kind of plant. As Mr. F. Bond informs me that he has often seen moths visiting papilionaceous flowers, even such small ones as those of the trefoil, it has occurred to me that small moths may suck the flowers of *T. procumbens* and of *V. hirsuta*. From analogy we must believe that the smaller clovers secrete nectar; and it does not seem probable that the nectar would be wasted. I should esteem it a great favour if any Lepidopterists would communicate their experience on this point.—CHARLES DARWIN, Down, Bromley, Kent.

[In reply to Mr. Darwin's enquiry we may observe that very many of the Tineina are provided with tongues, and that these appendages are naturally used in extracting the sweets of flowers. It is no uncommon sight to see an Umbellifer swarming with the pretty little *Glyphipteryx Fischeriella*, each with its proboscis extended sucking at the flowers. The *Depressaria*, as is notorious to every collector of Noctux, come very freely to sugar, and no doubt naturally visit flowers.

But the fertilization of flowers may be accomplished by insects in another way. Many species oviposit on the blooming flowers; they do not deposit all their eggs on a single plant, but sparingly a

be optional; but no one should be permitted to offer himself unless he had already received a certificate of having passed. As this would be one of great importance it ought not to be accessible to men under the age of 25. It should consist—1, of *Vegetable physiology* in its relation to the functions of plants; 2, of *Geography*, so far as the native countries of cultivated plants and the climate; to which they are naturally exposed are concerned; 3, of *Climate*, that is to say of the influence exercised upon plants by temperature, moisture, &c. These three subjects might be taken by the Society of Arts.

LEMAYE further proposes a *Psychological Examination*, for the purpose of ascertaining the knowledge of various kinds of fruit, which he thinks Mr. Hoos as Secretary of the Psychological Committee might be induced by the Horticultural Society to undertake. And to all these he would add so much of *Mathematics* as are required for understanding the first book of Euclid; but he would allow any candidate to decline this subject without prejudice.

Such are LEMAYE'S proposals, not put altogether in his own language, which required condensation and arrangement, but expressed in a methodical way. We cannot say that we wholly concur in every part of the scheme, but we regard it as a good basis, upon which something valuable may be built, and experienced gardeners will take it sociably into consideration and point out how it may be improved.

THE EDUCATION OF GARDENERS.

The following scheme for entering to young men learning to be gardeners an economical education better suited to their wants than they can now obtain is submitted to the consideration of those who have to guide their course, whether as friends, guardians, or parents—

- I.—**PRELIMINARY EXAMINATION.**
(To be passed at any time between the ages of 18 and 21.)
- 1. Writing
- 2. Spelling
- 3. Arithmetic, including book-keeping and timber measuring
- 4. Land surveying
- II.—**PAUSE EXAMINATION.**
(To be passed between the ages of 21 and 25.)
- 5. Practical skill in cultivation
- 6. Practical survey and raising plants at sight
- III.—**EXAMINATION FOR HONOURS.**
(To be passed between the ages of 25 and 30.)
- 7. Vegetable physiology, in its relation to cultivation
- 8. Geography, so far as it relates to vegetation
- 9. Climate, in its relation to vegetation
- 10. Mathematics (optional), not to go beyond the first book of Euclid
- 11. Botany, naming fruits at sight

Local Institutions, or Clergy.

Some 'first-class gardeners.

Secretary of the Floral Committee of the Hort. Society.

Society of Arts.

Do.

Do.

Do.

Secretary of the Psychological Committee of the Horticultural Society.

Layover.

FERTILISATION OF BRITISH ORCHIDS BY INSECT AGENCY.

I SHOULD be extremely much obliged to any person living, where the Bee or Fly Orchid is tolerably common, who will spare the kindness to make a few simple observations on their manner of fertilising them. To render the subject clear to those who know nothing of botany, I must briefly describe what takes place in our common British Orchids. The pollen-grains form two pear-shaped masses; each bears on a foot-stalk, with a sticky gland at the end. The pollen-masses are hidden in a tube, which is open in front. When an insect visits a flower, it almost necessarily, owing to the position of the parts, uncovers and touches the sticky glands. These firmly adhere to the head or body of the insect, and thus the pollen-masses are drawn out of their pouches, are dragged over the broad stigmatic surface, and the plant is fertilised. So beautifully are the relative positions of adhesive ends of the gland, and of the grains of pollen to each other and to the stigmatic surface naturally adapted, that an insect with an adherent pollen-mass will drag it over the stigmas of several flowers, and leave granules of pollen on each. The contrivance by which the sticky glands are prevented from drying, and so kept always viscid and ready for action, is in the two species which bear on the stigmatic surface a hemispherical cap, full of liquid, and formed of a gelatinous substance, that the sids projecting over the gateway into the nectary is ruptured transversely and depressed by the slightest touch; and thus the glands, sticky and fresh out of their bath, immediately and automatically come in contact with and adhere to the body which has just ruptured the bath. It is certain that with most of our common Orchids insects are absolutely necessary for their fertilisation.

tion, or without their agency, the pollen-masses are seen removed and either within their pouches or on the stigmatic surface. I have proved this in the case of *Orchis*, by covering up by glass the plants under a bell-glass, leaving other adjoining plants uncovered; in the latter I found every morning, as the flowers became fully expanded, some of the pollen-masses removed, whereas in the plants under the glass all the pollen-masses remained undisturbed in their pouches.

Robert Brown, however, has remarked that the fact of all the species in a dense sylvan of certain Orchids producing seed seems hardly reconcilable with their fertilisation having been accidentally effected by insects. But I could give many facts showing how effectually insects do their work; two cases will here suffice; in a garden in one of our woods with 54 flowers open, the 12 upper ones, which were all covered by glass, had no pollen-masses removed, whereas every one of the 32 lower flowers had one or both pollen-masses removed; in a plant of *Gymnadenis conopsea* with 54 flowers open, 52 had their pollen-masses removed. I have repeatedly observed in various Orchids grains of pollen, as in one of our woods, on the stigmatic-masses on the stigmas of a flower, which were all covered by glass, and two pollen-masses; and as often, or even oftener, I have found flowers with the pollen-masses removed, but with no pollen on their stigmas. These facts clearly show that each flower is often, or even generally, fertilised by the pollen brought by insects from another flower or from some other plant. After observing one Orchid during many years, I have never seen a bee or any other diurnal insect (excepting only a butterfly) visit them; therefore I have no doubt that swells are the insects who perform the marriage ceremony. The structure, indeed, of some Orchids leads to this same conclusion; for as insect without a very long and extensive proboscis could possibly reach the nectary at the bottom of the tube, the narrow neck of the tube of the Butterfly-Orchid; and *Entomobrya* has been occasionally captured moths with pollen-masses adhering to them. If any entomologist reads this, and can remember positively having caught a moth thus furnished, I hope he will give its name, and describe as exactly as he can the part of the moth's body the sticky gland adhered.

We may now turn to the genus *Ophrys*; in the Fly Orchid (*Ophrys sphegodes*), the pollen-masses, furnished with sticky glands, do not naturally fall out of their pouches, nor can they be shaken out; so that insect-agency is necessary, as with the species of the other genera, for their removal. But insects here do their work far less effectually than in the common Orchids; during several years, previously to 1858, I have been in the state of the pollen-masses in well-grown flowers of those plants which I examined, and out of 102 flowers I found either one or both pollen-masses removed in 13 other ones. But in 1858 I found 57 flowers and 29 flowers had one or both pollen-masses removed; and as all the remaining 27 flowers were the upper and younger flowers, they probably would subsequently have had most of their pollen-masses removed, and thus have been fertilised. I should much like to hear how the case stands with the Fly Orchid in other districts; for it seems a strange fact that a plant which grows pretty well, as it does in this part of Kent, and yet during several years seldom be fertilised.

When we come to the Bee Orchid (*Ophrys apifera*), which presents a very different case; the pollen-masses are furnished with sticky glands, but differently from in all the foregoing Orchids; they naturally fall out of their pouches, and from being of the proper length, though still retained at the gland-stalk, they fall on the stigmatic surface, and the plant is thus self-fertilised. During several years I have examined many flowers, and never in a single instance found even one of the pollen-masses carried away by an insect; and as the flower's own pollen-masses fall to fall the stigmas of the Bee Orchid consequently I believe that the visits of insects would be injurious to the fertilisation of this Orchid; and rather profitably imagined that the flower resembled a bee in itself, the latter out of the pollen-masses of this Orchid is a very common occurrence. In the other British Orchids, as our experience goes, a person visiting a specimen, for I have always found this to be the case; I have made a long course of observation has made no greatly doubt whether the flowers of any kind of plant are for a perpetuity of generations fertilised by their own pollen. And what are we to say with respect to the sticky glands of the Bee Orchid, the use and efficiency of which goes, in the other British Orchids, as are so manifest? Are we to conclude that the insect agency is provided with these organs for no use? I cannot think so; but would rather infer that, during some years or in some other districts, insects do visit the Bee Orchid and occasionally transport pollen from one to another, and thus give it the advantage of an occasional cross. We have seen that the Fly Orchid is not in this part of the country by any means so frequently often visited by insects, though the visits of insects are indispensable to its fertilisation. So with the Bee Orchid, though its self-fertilisation is specially provided for, it may not exist here under the most favourable circumstances; it may be visited by insects, and during particular seasons it may be visited by insects,

and in this case, as its pollen-masses are furnished with sticky glands, it would almost certainly produce the effect of an occasional cross impregnation. It is the curious apparent contradiction in the structure of the Bee Orchid, which is to carry the sticky glands, being adapted for fertilising by insect agency—another part, namely the natural falling out of the pollen-masses, being adapted for self-fertilisation without insect agency—which makes the confusion of a hour what happens to the pollen-masses of the Orchid in other districts or parts of England. I should be extremely much obliged to any person who will take the trouble to observe this point and to communicate the result to the *Gardeners' Chronicle* or to Mr. Charles Darwin, Down, Bromley, Kent.

THE CROWN ESTATE OF CHOPWELL WOOD.

I SAW a statement in a public paper the other day showing the income and expenditure of the Crown estate of Chopwell Woods, in the county of Durham, from May 1858 to May 1859; and as it was given in such a way as to bring out the actual result of the system of management which has been pursued, compared with that which would have been the case had it been detailed in the thirty-third volume of the *Annals* of H.M. Woods and Forests, bearing date November 21, 1852, I think it right, in justice to both the Right Hon. T. F. Kennedy and myself, to refer very shortly to the results as now brought out.

In December 1851 Mr. Kennedy, who was then Secretary of the office of H.M. Woods and Forests, requested me to take charge of the management and plantations at Chopwell, and to report to him my opinion in regard to them; and this I did in a report to him dated December 31 of the year last named. The substance of my recommendations in regard to this property of the Crown may be summed up thus:—“Seeing that the existing stock of wood on these lands, to the extent of 579 acres, was in a very unhealthy state, in consequence of past neglect, that the stock now produce more than one-eighth of the value it would have done had it been in time attended to and well managed, I would strongly advise to have the crop on the extent above specified entirely cut down, and to plant the same with a good quality of seed, and to replant with Larch, which I think it is well adapted.” I stated in my report that “the most value of the crop on the extent above to be cleared was 11,138*l.*, and that although it should be allowed to stand for other 20 years it could not at the end of that period be worth more than 15,100*l.*, while if it were now cut, and replanted immediately after, there would, under the best management, exist upon the same land in 20 years after the termination of planting, a crop of Larch worth at least 17,000*l.*”

After a great deal of discussion with the Treasury in respect to my recommendations for the improvement of this woodland property of the Crown, Mr. Kennedy was authorized to put them in operation and to carry them out as far as the management of the estate; and the result is that 15,079*l.* has been realized by the sale of the wood upon the 779 acres recommended to be cleared, which is 394*l.* more than my valuation of it at the time. This difference is accounted for from the facts that in 1851, when I valued the crop in these woods, the price of such small trees as it consisted of was very low, and that in about one year afterwards it rose nearly 20 per cent. As to the Larch, however, the result is doubtless satisfactory to all parties.

With regard to the expenditure, I estimated the cost of clearing, draining, and replanting at 4767*l.* 1*s.* 6*d.* In all, while the actual result is an expenditure of 4702*l.* 6*s.* 6*d.* This, then, must also be considered satisfactory, and especially so, as the property of the Treasury has acted so judiciously and judiciously, and the success of all the operations he has now completed for the improvement of the Chopwell Woods; that Mr. Kennedy, in appointing him to the charge, put the right man in the right place; and that if he (Mr. Kennedy) were retained in the office of Woods, the improvements he could have effected, in respect to the other woodlands of the Crown, would have been the same, with equal success, as he has now effected.

With regard to the crop of Larch which has been planted on the 779 acres which were cleared at Chopwell, I may only remark that it is in the most promising condition possible, and gives evidence that the land is now well covered with trees to even more than the value which I anticipated, and which I stated in my report on the subject. In proof that the crop is making satisfactory progress, I may only state that although the oldest portion of it is only six years planted, thousands of the trees are already upwards of 25 feet tall. This extraordinary result is no more than I expected when I recommended the planting of this estate with Larch, and goes to prove the wisdom of the management through and well-conducted system of drainage in the clearing of healthy Larch plantations.

Mr. Clutton, however, did not anticipate such a state of things in regard to the clearing and replanting of the estate of Chopwell, as he states in his report on p. 24 at page 215 of the *Annals* referred to above, “I would not advise the clearing and replanting of the ground; if it is only partially cleared and replanted, the shelter of the remains of the present crop would be found highly useful.” He does not state any exact drainage, and at page 219 he seems to infer that it